The most important domestic plant species are those belonging to *Triticum* L. genus, particularly hexaploid bread wheat (*Triticum aestivum* ssp. *aestivum*) and tetraploid durum wheat (*T. turgidum* ssp. *durum*). Hemibiotrophic *Fusarium* species, hemibiotrophic pathogen *Zymoseptoria tritici*, necrotrophic fungi *Parastagonospora nodorum* and biotrophic pathogen *Blumeria graminis* f. sp. *tritici* are considered to be most dangerous fungal pathogens infecting wheat. The presence of constitutive morphological barriers (trichomes, stomatal pores and waxes) plays major role in plant resistance to pathogens infections along with activation of defense responses comprising trichothecenes glycosylation and wheat ability to recognize protein effectors. The aim of the research was to acquire in-depth knowledge concerning molecular interactions between wheat and fungal pathogens. The susceptibility of spring wheat forms of different ploidy levels to *Fusarium* spp., *Z. tritici* and *B. graminis* f. sp. *tritici* infection and diseases stages caused by these pathogens stages were evaluated. The presence examination of *Fusarium* spp. species on wheat grain and glumes and analysis of *F. graminearum* and *F. culmorum* genotypes were conducted. The biochemical response on cellular level of bread wheat and spelt to biotic stress after *F. culmorum* inoculation was also evaluated. The ability of reactive oxygen species (ROS) synthesis and phenylalanine ammonia-lyase (PAL) activity was compared in bread wheat and spelt tissues.

The plant material used in conducted research for this doctoral thesis was: diploid taxon *T. monococcum* ssp. *monococcum*, tetraploid taxons *T. turgidum* ssp. *durum*, *T. turgidum* ssp. *polonicum*, *T. turgidum* ssp. *dicoccum*, hexaploid taxons *T. aestivum* ssp. *spelta* and *T. aestivum* ssp. *aestivum*. The health status of 600 *Triticum* genotypes was evaluated in 2014. The resistance to fungal infection of 200 *Triticum* genotypes was assessed in 2015 in field experiment carried out in North-East Poland. In 2016-2017 the susceptibility of 7 wheat lines/varieties to *Z. tritici* and *B. graminis* f. sp. *tritici* was evaluated during micro-field experiment. In 2016 two green-house experiments were designed. The analyzed wheat species were inoculated with spore suspension of *F. culmorum* and *Z. tritici*. The *Fusarium* pathogens were plated on potato dextrose agar and identified microscopically and molecularly with the use of PCR (*polymerase chain reaction*) technique, PCR-ITS (*internal transcribed spacer*) and multiplex PCR. The morphological characteristics of analyzed wheat species was evaluated using scanning electron microscope. The analysis of phenylalanine ammonia-lyase activity was determined during synthesis reaction of cinnamic acid. Additionally, a confocal microscope was used to observe the accumulation of reactive oxygen species during *F. culmorum* infection process in wheat tissues.

The conducted field experiments and laboratory analyses allowed to investigate an interaction between wheat and fungal pathogens. Pathogen *Zymoseptoria tritici* is a hemibiotroph entering plant tissues mainly through stomatal openings. *F. culmorum* and *F. graminearum* species are considered as hemibiotrophs and their virulence is determined by the mycotoxins producing ability. *Parastagonospora nodorum* species is a necrotroph which in initial infection stages is producing enzymes degrading cell walls, proteins and carbohydrates accumulated in plant cells. In contrast, *Blumeria graminis* is an obligate biotroph developing on the plants surface.

In field and green-house experiments, bread wheat was usually significantly infected by fungal pathogens under natural conditions, while relict wheat species- Polish wheat and emmer exhibited average susceptibility to infections. Typically einkorn did not showed any symptoms of infections caused by fungal pathogens.

Among analyzed *F. culmorum* and *F. graminearum* genotypes conditioning mycotoxins production, dominated NIV (nivalenol) and 3-ADON genotypes. The structure and number of constitutive barriers differ between investigated wheat species. Most of the relict wheat species were characterized by greater number of trichomes on the leaves surface then analyzed lines/varieties of bread wheat and greater number of stomatal opening then bread wheat variety Sumai3. Different structure of waxes covering wheat leaves between analyzed wheat species was also observed. The defense response differ between resistant bread wheat and spelt lines. In spelt, the ROS content remained high for five days after plants inoculation with *F. culmorum*. In resistant bread wheat variety Sumai3, low level of ROS synthesis and accumulation and activity phenylalanine ammonia-lyase activity increasement of were observed.